DOCUMENT RESUME

ED 204 135 SE 035 232

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TITLE Predicting Science Achievement of University Students on the Basis of Entry Characteristics: A Replicated Study.
PUB DATE Apr 81
NOTE 12p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (54th, Grossinger's in the Catskills, Ellenville, NY, April 5-8, 1981). For related document, see SE 035 231.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; *Biology; College Science; *College Students; Grade Point Average; Higher Education; Locus of Control; *Predictor Variables; Science Education; *Student Characteristics; Student Motivation
IDENTIFIERS *Science Education Research

ABSTRACT

Reported are results of a replicated study designed to examine the relationships between university students' entry characteristics and achievement in biological science. Variables selected for examination included scholastic aptitude test (SAT) scores (quantitative and verbal); locus of control; grade point average; and achievement motivation. Data on characteristics of introductory biology students (N=175) were collected through standardized tests or from student files. Data on achievement variables were collected with multiple-choice objective referenced tests. A total of four achievement tests was administered across one semester of study. Regression analysis and general linear model procedures were used to examine the data. Results include the finding that GPA was the single best predictor, with SAT (quantitative or verbal) as the second best predictor. Results are compared to the original Georgia study. (CS)

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PREDICTING SCIENCE ACHIEVEMENT OF UNIVERSITY STUDENTS ON THE BASIS OF ENTRY CHARACTERISTICS: A REPLICATED STUDY

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A paper presented at the annual meeting of the National Association for Research in Science Teaching, New York, April 1981.

SE 035 232

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INTRODUCTION

Purpose

Variation in university students' science achievement is related to many variables. Instruction related variations are responsible for some differences in achievement but other sources of variation which must be considered are student entry characteristics that are not manipulable but need to be identified and recognized for their influence on science achievement. Bloom (1976) has stated that more learning is influenced by a student's entry characteristics than by variations in teaching. The purpose of this study was to examine the relationships between university students' entry characteristics and achievement in biological science. It is a replication of a similar study conducted at the University of Georgia and is based on an ex-post-facto analysis of data from similar biology classes at North Carolina State University. The variables in the Georgia study included: scholastic aptitude (quantitative and verbal); locus of control; and grade point average. This study examined the above, expanded the measurement of locus of control, and added achievement motivation as a potential predictor of achievement.

Variable Selection

Scholastic aptitude as measured by the SAT was selected because of its use as a university entrance examination. However, its predictive power is severely limited by a restricted range. Nevertheless, the nature of the concepts and problems being studied and the nature of the pedagogy (much

reading and lecture) suggests that variations in scholastic ability may lead to or predict variations in science achievement.

Student locus of control (LOCUS) was selected as a predictor variable because of the high level of freedom and independence associated with the task of studying. This freedom should favor students with an internal locus of control. The external student may not recognize regular and systematic study as a variable responsible for increased achievement.

Grade point average (GPA) was needed to examine the degree of relationship that exists between success in biology and general success in other university courses. Any relationship would be strictly correlational (as opposed to causal) but may point the way to identifying the causal variables.

Achievement Motivation was selected to measure the influence of the need to achieve on science learning and to measure the relationship of motivation and locus of control as suggested in the attribution theory of Weiner (1972).

PROCEDURES

Subjects

The subjects in this study were 175 university students enrolled in an introductory biology course at North Carolina State University; data were collected during Spring 1980. All students who had a complete data set were included in the analysis.

Data Collection

Data on the entry variables were collected through standardized tests or from student files. Locus of control was assessed using Levenson's (1973) instrument. Achievement motivation was measured with the Mehrabian (1978)

instrument. Qualitative and quantitative SAT data and GPA were available in conventional university computer stored records.

Data on all achievement variables were collected with multiple-choice objective referenced tests. All items had been piloted previously and existed in a computer pool of items for the course. Item analysis was used to establish reliabilities while content validity was insured by a panel including science professors and the research staff. A total of four achievement tests were administered across one semester of study.

Data Analysis

Data were examined by using regression analysis and general linear model procedures with SAS computer programs. Student achievement on the four tests was identified as separate dependent variables while scholastic aptitude (SATQ and SATV), locus of control (LOCUS), achievement motivation (ACHMOT), and GPA were independent variables.

Since there were two instructors involved with the course, slight variations existed in the achievement tests. To compensate for this, all achievement scores were converted to standard within class z scores for the analysis. Also, the Georgia and North Carolina data were analyzed as one data set; similarly, z scores represented the achievement data for both populations in this analysis.

RESULTS

On all of the achievement measures, GPA was the single best predictor with R^2 values of .42, .55, .47 and .53 (see Table 1). The second best predictor was SAT (quantitative or verbal) where R^2 equaled .17, .18, .09 and .09. The best model for predicting success on the first exam was a three

variable model including GPA, LOC and SAT (quantitative) where 47% of the achievement variance was predicted. On the second exam the same model predicted 57% of the variance. For the third and forth exam the best model was a single variable model where GPA predicted 47% and 53% of the variance.

Because GPA is not a measure of any single characteristic but is probably influenced by the other variables being examined in this study, regression models which excluded GPA were tested. In all cases SAT (quantitative or verbal) then emerged as the single best predictor of achievement (see Table 2).

As mentioned earlier, the Georgia and North Carolina data were analyzed as a single data set. The results of this analysis indicated that the results are generalizable across settings. That is, GPA is the best single predictor of success in college biology followed by SAT. Two interesting interactions did appear when the location of the study was considered as a variable. The first was an interaction between the study site and locus of control, where the variable was a positive predictor of success for North Carolina and negative for Georgia students (see Figure 1). The second was an interaction between the study site and SATV. Again the variable is a positive predictor of achievement for North Carolina students and negative for Georgia students (see Figure 2).

CONCLUSIONS

When this study is compared to the original Georgia study, some similar results are evident in that generally the same variables predict achievement in science; although, the order and magnitude of the variables move around. But, this was also true within the original study. There is a difference

in the prediction slopes between studies for locus of control and SATV; where, the directions are opposite. In any case, the improvement of post-secondary science instruction and the resultant learning outcomes requires continual attention. More developmental and research efforts should be applied in this area. Some attention should also be given to ensure that students of varying (especially low) entry skills and abilities are provided with instruction which provides means of improving these skills and abilities. There is a possibility that solving problems similar to those in a science unit could stimulate the development of these skills. Also, when the primary purpose of instruction is to aid the learning of a particular set of concepts or skills, (e.g., genetics) pedagogical methods designed to help overcome deficient student entry skills (e.g., quantitative ability) should be employed.

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Table 1

RESULTS OF MULTIPLE REGRESSION ANALYSIS SHOWING THE SINGLE AND BEST MULTIPLE-VARIABLE MODELS WHICH PREDICTED ACHIEVEMENT

	R^2	C_p	Variable	R^2	C_p	Variables in model
TEST 1	0.03	120.27	ACHMOT	0.422	11.82	GPA
	0.06	111.01	LOCUS	0.447	6.78	GPA SATV
	0.17	79.80	SATV	0.468	3.26	GPA SATQ LOCUS
	0.17	79.74	SATQ	0.470	4.51	GPA SATQ LOCUS SATV
	0.42	11.82	GPA			
TEST 2	0.01	191.84	ACHMOT	0.563	6.06	GPA
	0.04	182.12	LOCUS	0.568	2.96	GPA SATQ
	0.13	151.15	SATV	0.574	2.73	GPA SATQ LOCUS
	0.18	134.10	SATQ	0.576	4.29	GPA SATQ LOCUS SATV
	0.55	60.6	GPA			
TEST 3	0.01	128.96	ACHMOT	0.471	1.19	GPA
	0.03	125.30	LOCUS	0.476	1.80	GPA LOCUS
	0.05	118.41	SATQ	0.481	2.29	GPA LOCUS SATQ
	0.09	106.11	SATV	0.482	4.02	GPA LOCUS SATQ SATV
	0.47	1.19	GPA			
TEST 4	0.00	168.34	ACHMOT	0.526	2.69	GPA
	0.03	160.19	LOCUS	0.531	3.26	GPA LOCUS
	0.07	146.78	SATQ	0.536	3.18	GPA LOCUS ACHMOT
	0.09	139.80	SATV	0.541	4.00	GPA LOCUS ACHMOT SATQ
	0.53	2.69	GPA			
TOTAL*	0.01	228.93	ACHMOT	0.607	3.12	GPA
	0.05	216.87	LOCUS	0.618	0.73	GPA LOCUS
	0.14	182.67	SATQ	0.619	2.29	GPA LOCUS SATQ
	0.15	178.84	SATV	0.619	4.06	GPA LOCUS SATQ ACHMOT
	0.61	3.12	GPA			

* Test 1 + Test 2 + Test 3 + Test 4

Table 2

RESULTS OF MULTIPLE REGRESSION ANALYSIS (NOT INCLUDING GPA)
SHOWING THE SINGLE AND BEST MULTIPLE-VARIABLE
MODELS WHICH PREDICTED ACHIEVEMENT

Test	R^2	C_p	Variables in Models
1	.175	13.66	SATQ
	.219	7.03	SATQ, SATV
	.245	4.06	SATQ, SATV, ACHMOT
2	.179	4.99	SATQ
	.197	3.63	SATQ, LOCUS
	.207	3.79	SATQ, SATV, ACHMOT
3	.089	1.94	SATV
	.101	1.99	SATV, ACHMOT
	.106	3.21	SATV, ACHMOT, SATQ
4	.093	1.91	SATV
	.104	2.07	SATV, SATQ
	.110	3.04	SATV, SATQ, LOCUS
Average	.146	7.87	SATV
	.177	4.24	SATV, SATQ
	.190	3.81	SATV, SATQ, ACHMOT

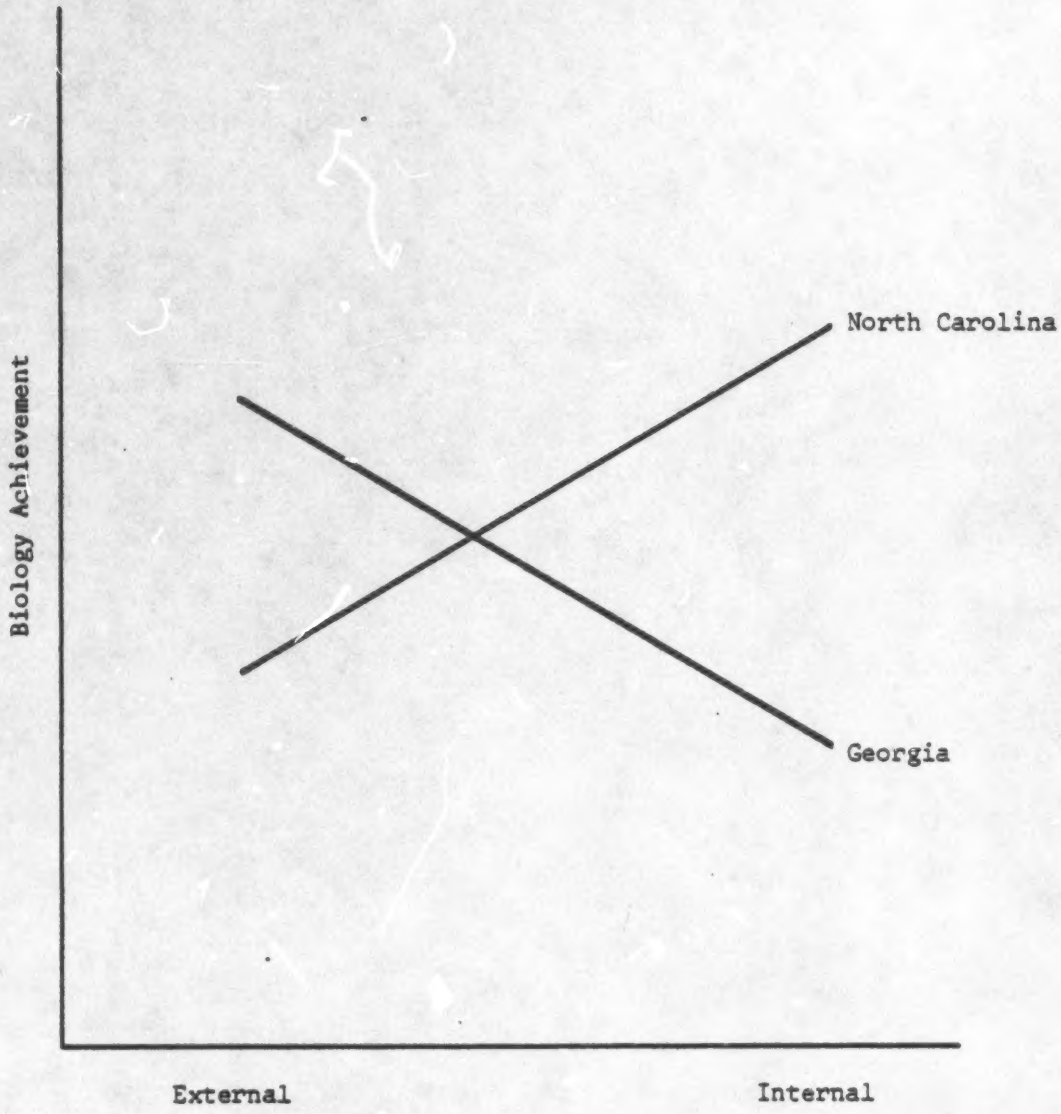

Figure 1. A graphic representation of the differential predictive nature of the Locus of Control variable for the Georgia and North Carolina data.

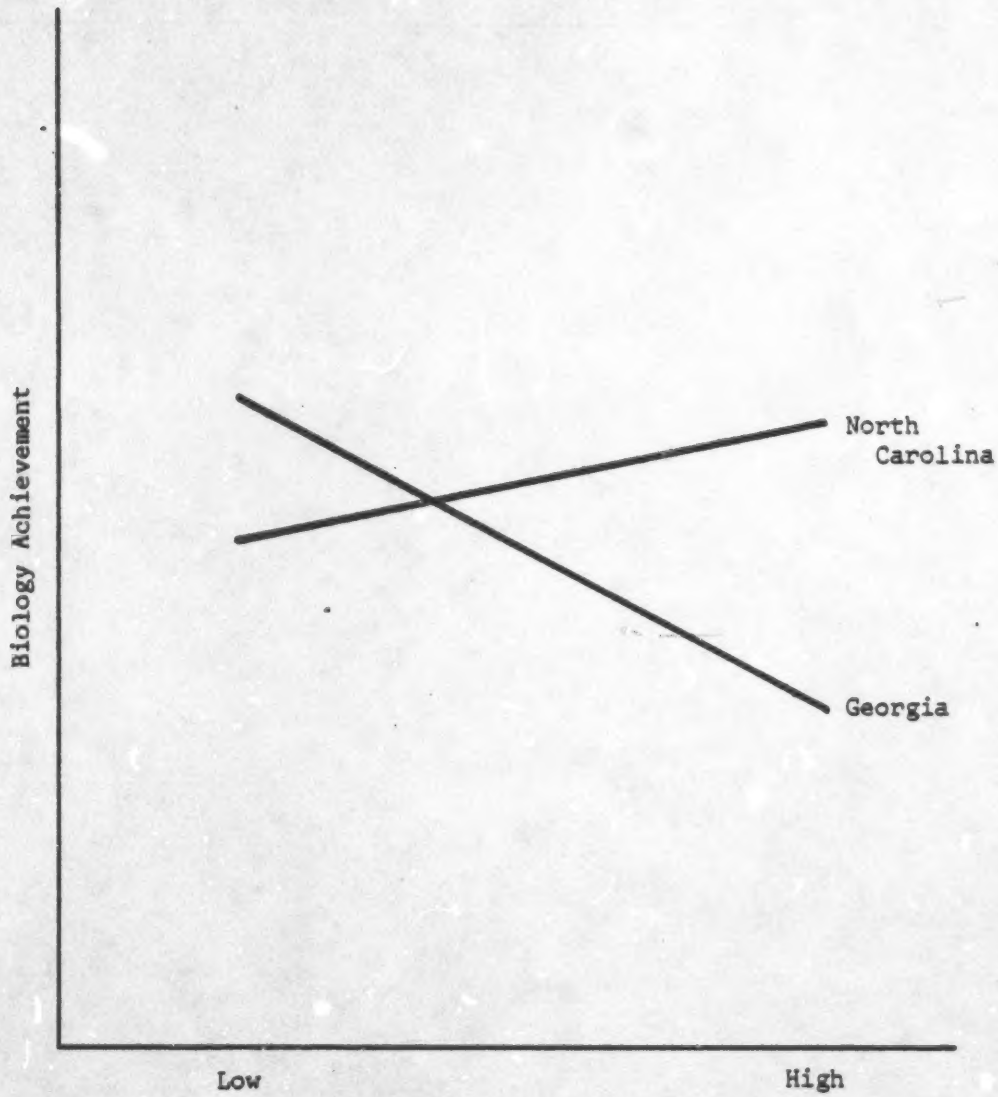

Figure 2. A graphic representation of the differential predictive nature of the SAT verbal variable for the Georgia and North Carolina data.